AMENDMENTS TO THE DRAWINGS:

The attached sheet of Drawings includes changes to Fig. 1. This sheet, which includes Figs. 1 and 2, replaces the original sheet including Figs. 1 and 2.

Attachment: Replacement Sheet.

REMARKS/ARGUMENTS

Claims 1-17 are pending in this application. By this Amendment, Applicants amend the specification, the drawings and claim 16, and cancel claim 18.

The drawings were objected to because Fig. 1 was not designated as --Prior Art-- and reference number 140 disclosed in paragraph no. [0020] of the originally filed specification was not included in the drawings. Applicants have amended Fig. 1 to be properly designated as --Prior Art--, and have amended paragraph no. [0020] to remove reference number 140. Accordingly, Applicants respectfully request reconsideration and withdrawal of these objections.

Claims 1-6 were rejected under 35 U.S.C. § 102(b) as being anticipated by Bernier et al. (U.S. 6,069,023). Claims 1, 7 and 8 were rejected under 35 U.S.C. § 102(e) as being anticipated by Utagikar et al. (U.S. 6,583,513). Claims 9 and 10 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Utagikar et al. in view of the remark. Claims 11, 12, 16 and 17 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bernier et al. in view of the remark. Claim 13 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Bernier et al. in view of Chen et al. (US 2003/0150595. Claims 14 and 18 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bernier et al. in view of Alcoe et al. (U.S. 6,570,259). Claim 15 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Bernier et al. in view of Shaw et al. (U.S. 5,330,701). Claim 18 has been canceled. Applicants respectfully traverse the rejections of claims 1-17.

Claim 1 has been amended to recite:

> "An integrated circuit package comprising:
> a substrate having first and second surfaces and a plurality of conductive traces therebetween;
> a semiconductor die flip-chip mounted to said first surface of said substrate and electrically connected to ones of said conductive traces;
> **an intermetallic heat spreader fixed to a back side of said semiconductor die**; and

> a plurality of contact balls disposed on said second surface of said substrate, in the form of a ball grid array, ones of said contact balls of said ball grid array being electrically connected with ones of said conductive traces." (emphasis added)

Applicants' claim 16 recites features that are similar to the features recited in Applicants' 1, including the above-emphasized feature.

With the unique combination and arrangement of elements recited in Applicants' claims 1 and 16, Applicants have been able to provide a flip-chip ball grid array integrated circuit package having improved thermo-mechanical properties and reduced stress at the solder ball interconnects, and that inhibits the die from warping (see, for example, paragraph nos. [0010] and [0012] of the originally filed specification).

The Examiner alleged that Bernier et al. teaches all of the features recited in Applicants' claims 1 and 16, including an intermetallic heat spreader, and that Utagikar et al. teaches all of the features recited in Applicants' claim 1, including an intermetallic heat spreader. Applicants respectfully disagree.

In contrast to the Examiner's allegations, Bernier et al. fails to teach or suggest the use of an intermetallic heat spreader, as recited in Applicants' claims 1 and 16. The Examiner alleged that Bernier et al. teaches the use of an intermetallic heat spreader at col. 15, lines 35-36. However, col. 15, lines 35-36 of Bernier et al. discloses the use of an aluminum alloy for the heat sink. Bernier et al. further discloses, in col. 15, lines 37-39, "anodizing a connection surface of the aluminum heat sink." Thus, contrary to the Examiner's allegation, this section of Bernier et al. fails to teach or suggest the use of an intermetallic as a heat spreader. In fact, Bernier et al. fails to teach or suggest the use of **any** intermetallic material whatsoever.

Bernier et al. is directed to electronic components including heat spreaders or heat sinks. As disclosed in Bernier et al., aluminum or copper heat sinks are attached to a ceramic cap or exposed semiconductor chip using a silicon or flexible-epoxy adhesive. Col. 9, lines 12-17 of Bernier et al. discloses that "the heat spreader may be

Al which may be treated by anodization or coated with chromium conversion coating. More preferably, the heat spreader is Cu which may be treated by chromate conversion or more preferably coated with Ni. The nickel coating may be formed on a clean copper by electrolessly plating or electroplating."

Bernier et al. fails to teach or suggest anything at all about the heat sink or a heat spreader being made of an intermetallic compound as recited in Applicants' claims 1 and 16. As described in the originally filed specification of the present application, an intermetallic compound is a stoichiometric combination of metallic ions that form bonded matrices of crystals. Bernier et al. fails to teach or suggest anything at all about intermetallic compounds, and certainly fails to teach or suggest an intermetallic heat spreader.

The use of an intermetallic compound, such as copper aluminide, fixed to the semiconductor die provides an effective heat spreader for dissipating heat away from the semiconductor die of the package. The intermetallic compound can be selected to have a coefficient of thermal expansion that is close to that of a typical motherboard and an elastic modulus that is high to restrain the semiconductor die, thereby reducing stress at the solder ball interconnects and inhibiting the die from warping. Intermetallic compounds have unique thermal-mechanical properties that are significantly different from the alloys taught by Bernier et al. Specifically, metallic alloys such as copper and aluminum typically used in heat sink applications in the prior art have much greater thermal expansion than silicon.

The disclosure of an aluminum alloy for the heat sink or anodizing a connection surface of the aluminum heat sink is not equivalent to the use of an intermetallic compound in the integrated circuit package. An aluminum alloy is **not** an intermetallic compound. In addition, anodizing a surface merely involves subjecting the element to an electrolytic process in order to coat the element with a protective film. This is clearly **not** the same as using an intermetallic compound in the integrated circuit package.

Thus, Applicants respectfully submit that, contrary to the Examiner's allegations,

Bernier et al. clearly fails to teach or suggest the unique combination and arrangement of elements recited in Applicants' claims 1 and 16.

The Examiner alleged that col. 5, lines 64-67 and col. 6, lines 1-31 of Utagikar et al. teaches an intermetallic heat spreader 144. This is clearly incorrect.

In contrast to the Examiner's allegations, col. 5, lines 64-67 and col. 6, lines 1-31 of Utagikar et al. teach that "the lead 144 is made, for example, of a metal or metal alloy and serves to conduct heat away from the integrated circuit 110." Thus, rather than teaching the use of an intermetallic for the lead 144, Utagikar et al. teaches the use of a metal or metal alloy lid. As described above, a metal or metal alloy is clearly not the same as an intermetallic compound which is a stoichiometric combination of metallic ions that form bonded matrices of crystals. Thus, similar to Bernier et al., Utagikar et al. fails to teach or suggest anything at all about an intermetallic, and certainly fails to teach or suggest "an intermetallic heat spreader" as recited in Applicants' claims 1 and 16.

With respect to claim 15, the Examiner alleged that Bernier et al. teaches the claimed in claim 15 except for an intermetallic compound that includes NiAl. The Examiner further alleged that Shaw et al. teaches an intermetallic compound that includes NiAl. Thus, the Examiner concluded that it would have been obvious "to form the intermetallic compound comprises NiAl as taught by Shaw [et al.] in order to have the attractive characteristics of low density, high strength, good corrosion and oxidation resistance, a relatively low cost." Applicants respectfully disagree.

As described in detail above, contrary to the Examiner's allegations, Bernier et al. fails to teach or suggest <u>any</u> intermetallic compound, and certainly fails to teach or suggest an intermetallic heat spreader. In contrast, Bernier et al. merely teaches aluminum or copper heat spreaders, which are very different from intermetallic heat spreaders.

Shaw et al. teaches a process for making finely divided intermetallic and ceramic powders for use as binders for cutting tools and for injection molding using the powders.

The Examiner is reminded that "[i]n order to rely on a reference as a basis for

rejection of an applicant's invention, the reference must either be in the field of applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the inventor was concerned." See In re Oetiker, 24 USPQ2d 1443, 1445 (Fed. Cir. 1992) and MPEP § 2141.01(a). That is, the Examiner must rely upon analogous art to reject Applicants' claims.

The present invention is directed to an integrated circuit package including a heat spreader, as recited in the claims. In contrast, Shaw et al. is directed to the field of manufacturing finely divided intermetallic and ceramic powders fur use as binders for cutting tools and for injection molding using the powders. Thus, the present invention and Shaw et al. are clearly in different fields of endeavor.

The present invention is directed to solving a problem of improving thermo-mechanical properties, reducing stress at the solder ball interconnects and inhibiting the die from warping (see, for example, paragraph nos. [0010] and [0012] of the originally filed Specification). In contrast, Shaw et al. is directed to solving the problem of producing finely divided intermetallic and ceramic powders for use as binders for cutting tools. Thus, the present invention and Shaw et al. are clearly directed to solving different problems experienced with entirely different devices from two completely different fields of endeavor.

Accordingly, Applicants respectfully submit that Shaw et al. is clearly non-analogous art and that the Examiner has improperly relied upon Shaw et al. to reject claim 15. Thus, Applicants respectfully submit that there would have been absolutely no motivation to combine the teachings of Shaw et al. with Bernier et al., as alleged by the Examiner.

Chen et al. and Alcoe et al. were relied upon to alleged cure various deficiencies of Bernier et al. However, neither Chen et al. nor Alcoe et al. teaches or suggest "an intermetallic heat spreader" as recited in Applicants' claims 1 and 16. Thus, Applicants respectfully submit that Chen et al. and Alcoe et al. fail to cure the deficiencies of Bernier et al. described above.

Accordingly, Applicants respectfully submit that Bernier et al., Utagikar et al., Shaw et al., Chen et al. and Alcoe et al., applied alone or in combination, fail to teach or suggest the unique combination and arrangement of elements recited in Applicants' claims 1 and 16.

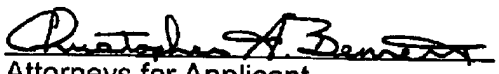
In view of the foregoing amendments and remarks, Applicants respectfully submit that Claims 1 and 16 are allowable. Claims 2-15 and 17 depend upon claims 1 and 16, and are therefore allowable for at least the reasons that claims 1 and 16 are allowable.

In view of the foregoing amendments and remarks, Applicants respectfully submit that this application is in condition for allowance. Favorable consideration and prompt allowance are solicited.

The Commissioner is authorized to charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 50-1353.

Respectfully submitted,

Date: January 14, 2005



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